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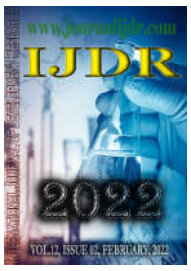

RESEARCH ARTICLE OPEN ACCESS

# IMPACTS OF LOGISTIC FACTORS ON EXPORTS: A STUDY ON THE BEHAVIOR OF TRANSPORT IN EXPORTS FROM THE SOUTHEAST REGION AND DESTINED FOR MERCOSUR

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## ABSTRACT

The Brazilian economy has a significant influence on some South American countries, which in general have a lower level of industrialization and depend on trade with Brazil to supply their markets with the most varied types of products. Highlights include mass consumption products, such as food and beverages. The companies producing these items have a large potential market in South America, and especially in MERCOSUR countries. However, in order to explore and profit from these markets, it is necessary to overcome great barriers, mainly the ones imposed by the transportation costs that the lack of logistical integration the region imposes on the respective companies. This research aims to identify how the exporting companies in the Southeast region are transporting their goods and how their geographical positions and other factors define the choices for the transportation modes to be used, as well as the related logistical impacts.Thus, results demonstrated that an integrated and balanced logistics in all its transport modes would give a much greater economic balance to the country, making the geographical locations of the companies' impact less on the respective international competitiveness.



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# INTRODUCTION

The possibility of consolidating Brazil as a strong regional leader among Latin American countries regarding the exportation of its products to the countries that compose the economic block called MERCOSUR relies on a better understanding of the adopted transport policy, as well as the different logistical factors related to the behavior of transport in exports. The so-called *weak centrality* of Brazil gives its products a competitive advantage for manufactured national products, but which have low aggregated technology. The less industrialized neighboring countries have proven to be viable markets for mass consumption products, such as food and beverages, for example. This scenario could be ideal for Brazilian companies, especially large and medium-sized ones. Accordingly, South American supermarkets should be crowded with Brazilian products and brands.

However, this is not the scenario that is seen in practice. The logistical barriers that exist on the continent impose serious obstacles to the regional expansion of Brazilian products. In this research, the dynamics of the Brazilian regional international trade was observed from the perspective of the logistics of mass consumption products, food and beverages, from three important states of the federation, Minas Gerais, Rio de Janeiro and São Paulo, two of which are the largest country's revenue stream generators. Through the analysis of foreign trade statistics, between 2011 and 2015, from these states to countries neighboring Brazil and members of MERCOSUR, Argentina, Bolivia, Paraguay and Uruguay, this research seeks to explain how the flow of transport on that commercial axis is developed. It is important to emphasize that the knowledge generated from this research is very relevant for exporting companies; tradings; international carriers; ship owners; customs brokers and even for the government, which can use them in order to better plan Brazilian logistics integration with other countries on the continent. This paper

has as main objective to analyze the logistic routes referring to the transport of food products and beverages produced in the states of Minas Gerais, Rio de Janeiro and São Paulo and exported to MERCOSUR countries. Through the researches carried out it was possible to identify which modes are currently used and which would be the most viable mode, in order to check in detail which are the most used routes and the factors that motivate the respective routes made.

# LITERATURE REVIEW

**Regional International Trade:** The exchange of goods between nations and long distance trade is not a new phenomenon. There is ample historical evidence that this type of commercial exchange was already present in the daily lives of ancient civilizations. In fact, trade between peoples has enriched empires, spread European languages around the world and, in some way, shaped the world we live in today (NORTHRUP, 2005). Trade between nations is motivated by their cultural, economic and geographical differences. These differences can cause the industry of a given country to have competitive advantages in manufacturing a product in relation to another country, thus bringing mutual benefits for both economies and societies. (KRUGMAN; OBSTFELD 2006). As interesting as assessing the benefits of trade, it is also interesting to assess how the flow is arranged between countries, that is, how the choice of trading partners is made. There are several studies on the subject and different variables are pointed out by the authors. They are cited: monetary union, exchange rate volatility, similarity of industrial structure, foreign trade measures, levels of productivity, existing comparative advantages in production, proportion of factors used in production, trade barriers and mainly, geographical distances between countries (ALMEIDA, SILVIO and CAMPOS, 2011; BAXTER and KOURAPTSIS, 2006; EATON and KURTON, 2002; HUMMELS, 1999).

Logically, some variables end up being more important than others, such as geographic distance. Since transportation costs have the same capacity to increase the sale of goods, as import taxes are expensive, it is easy to understand why this variable is so important. (KRUGMAN and OBSTFELD, 2006). The capacity and level of logistical service that a country can perform is directly associated with its performance in foreign trade, high transportation costs and the inefficiency in providing this type of service imposes trade barriers and still inhibits foreign direct investments affecting economic growth ( FARIA; SOUZA; VIEIRA, 2015). And as he quotes (Almeida; Silva; Campos, 2011) "two countries with lower transport costs between themselves tend to present a high level of bilateral trade". Due to this variable, neighboring countries are inclined to become major trading partners, which ends up promoting regional integration agreements such as free trade areas, customs unions, common markets and partial trade agreements. It is necessary to emphasize that geographical proximity is not the only motivating factor for the creation of regional economic blocks. In fact, the creation of these blocks is inserted in the context of globalization, and their dynamics of operation are very similar to the dynamics of global trade. (FLORENCIO; ARAUJO, 1996). By grouping into blocks, countries increase their bargaining power, put themselves in a more comfortable position to negotiate and, in the case of developing economies, seek to enter the world market (BAUMANN, 2005; GOMES, 2003). It is worth noting that countries that choose to stay outside the economic blocks or international treaties are at risk of isolating their own economy (MORE, 2002).

The Southern Common Market - MERCOSUR is the main economic block on the South American continent. Its participants are divided into “state parties” and “associated states”. In addition to the founding members (Brazil, Argentina, Paraguay and Uruguay), Chile, Peru, Colombia, Ecuador, Guyana and Suriname are currently associated states.Although there is currently criticism from certain segments of society about whether it is indeed beneficial for Brazil to continue participating in the block, due to the obstacles that its other members have been imposing in the negotiation of trade pacts with other blocks, it is evident that the commercial flow generated within the MERCOSUR is very important for Brazil. When observing the historical series that contains the positioning of MERCOSUR member countries according to the value that they imported from Brazil, it can be seen that with the creation of the block in 1991, MERCOSUR member countries began to become important markets for exports of Brazilian products. In fact, the economic dynamism can vary widely between countries. This heterogeneity causes duality in the dynamics of Latin American trade flows and it is observed that countries such as Brazil and Mexico, which have the largest GDPs in the region, are able to export industrialized products and their technologies to their neighbors with less developed economies (CORTADA, 2011). As a way of enabling easier international trade, several countries through a convention have created a common product nomenclature, or as it is known, the Harmonized System (HS). With a common language to all members, it is easier for the various national customs to be able to control and tax the products that enter their borders. (DIAS, 2008). The harmonized system created by MERCOSUR is known as the MERCOSUR Common Nomenclature (NCM). The NCM classifies various products according to their characteristics, in sections, chapters, positions and subheadings, respectively, from the most generic to the most specific.

**International Logistics and Regional Integration:** The logistical integration between the countries of South America has great deficiencies. Some difficulties are imposed by the region’s geography. The Amazon rainforest, the Andes mountain range and the pampas region serve as an example of these geographical limitations. Indeed, the region's historical roots influenced the current characteristics of South American infrastructure. The first roads and railways were built on the continent by Europeans. The main purpose was to transport raw materials from the various regions of the continent towards the coast, so that they could be shipped to Europe. This heritage and commercial dynamics have persisted until modern times and the periphery-center commercial logic means that very little has been invested in the logistical integration of South America. It is also possible to observe the influence that military strategic decisions of the past have until today in the region. Gauges of different standards were used in international rail connections in order to prevent them from being used in hypothetical military invasions of neighboring countries (NUNES, 2008). It is important to highlight that, as mentioned by Wanke; Hijjar (2009, p.145), “export is a multimodal operation by nature, with cargo being transported by highways, railways and waterways to the exit points, that is, ports and airports”. It is worth adding that in Brazil, in most cases, exports by rail will also need intermodality, being the only truly independent mode, the road mode.

**Road and Railway Connections / Connections:** Brazil connects by road to all MERCOSUR “states”. The road mode, as can be seen in the table below, is the mode most used in exports from Brazil to countries in this economic block (BRASIL, 2016).

**Table 1. Exports– Brazil x Mercosur – 2015**

| Exports by Modal: Brazil x Mercosur - 2015 | |
|---|---|
| Road | 65.23% |
| Maritime | 26.96% |
| Air | 5.70% |
| Others | 2.11% |
| Total | 100.00% |

Source: Alice Web (Ministry of Industry, Foreign Trade and Services).

The lack of options for other modes may explain the predominance of the road mode, but it is also worth pointing out that the use of this mode provides its own advantages and amenities. It is an extremely flexible modal, being able to serve the furthest areas of the continent at the moment its shippers need it. In addition, it is the only modal capable of carrying out door-to-door transport operations. Such an operation greatly reduces the risk of damage to the cargo, since it will not require overflow procedures. (CAIXETA FILHO, 2007;

CASTRO and LAMY, 1996; LÍCIO, 1995). It is also true that due to logistical deficiencies in the region, the road transport may be the only one capable of carrying out the routes required by exporters and importers. The border crossing points that register the largest export trade flows towards their neighbors are: (NUNES, 2008).

a) Brazil-Argentina: Uruguaiana / Pasos Libre; Foz do Iguaçu / Puerto Iguazu.
b) Brazil-Bolivia: Corumbá / Cochabamba; Guajará-mirim / Guyará Mirim.
c) Brazil-Paraguay: Foz do Iguaçu / Ciudad Del Este; Ponta Porã / Pedro Juan Caballero.
d) Brazil-Uruguay: Chuí / Chuy; Jaguarão / Rio Branco; Santana do Livramento / Rivera.

As seen earlier, regional rail integration is very deficient. The percentage of exports using this modal is low. Currently, Brazil has three international rail connections in operation (ALADI, 2000):

a) São Paulo - Santa Cruz (Bolívia), on the Corumbá - Arroyo Concepción border;
b) Buenos Aires - São Paulo, on the Pasos de los Libres - Uruguaiana border;
c) São Paulo - Montevideo, at the Livramento - Rivera border;

The stretch that connects São Paulo to the Bolivian city of Santa Cruz is operated, in Bolivia, by the company Ferrocarril Oriente S.A and on the Brazilian side by América Latina Logística (ALL). Brazil serves with the transport of exports of steel, coils, rebar and iron ore (SILVA, 2012). The section that connects Argentina's capital, Buenos Aires, to the Brazilian financial center, São Paulo, is also operated by ALL on the Brazilian side and belongs to the State on Argentina's side. Because there is a breakage of gauges, it is necessary to have cargo overflow in this stretch. The connection between Uruguay and Brazil (São Paulo - Montevideo) also requires cargo transshipment, it is another stretch operated by ALL. In 2015 this stretch was not responsible for any exports from Brazil to Uruguay.

**Maritime, River and Air Connections / Connections:** Transport by sea between Brazil and MERCOSUR is the second most used in the flow of exports. Ship owners such as Hamburg-Sud and Login Logística connect the main ports of the MERCOSUR region with maritime lines on a weekly basis. In Brazil, the most important ports for trade with MERCOSUR are the Ports of Santos, São Sebastião, Rio de Janeiro and São Francisco do Sul. The port of Santos is managed by Companhia Docas de São Paulo - CODESP, a port authority. The port can be accessed by highways: SP-055 (Padre Manoel da Nóbrega highway), Anchieta-Imigrantes system (ECOVIAS), SP-150 (via Anchieta), SP-160 (Rodovia dos Imigrantes) and BR-101 (Rio- Santos). And by railways: Malhas Paulista and Sudeste. It is the busiest port on the continent and has terminals for handling containers, fertilizers, solid bulk, sugar, soy and corn. In addition to having the most modern passenger terminal in Latin America and seven berths for loading and unloading ships specialized in cargo transportation with wheels (cars, buses and trucks mainly) known as Roll-on / roll-off (Ro-ro) ships ). It operates 24 hours a day and on weekends and holidays (ANTAQ, 2012a). The port located in the capital of Rio de Janeiro is managed by the port authority Companhia Docas do Rio de Janeiro (CDRJ). The port has road accesses: BR-040, BR-101, BR-116, RJ-071 and RJ-083; rail access: Southeast network operated by MRS Logística S.A; and pipeline access. In addition, it also has four terminal quays specialized in liquid, steel, wheat, passengers, solid bulk, paper reels, general and offshore cargo, containers and loading and unloading Roll-on / Roll-off vessels. (ANTAQ, 2012b). Also in the state of Rio de Janeiro there is also the port of Itaguaí, which is also managed by Companhia Docas do Rio de Janeiro - CDRJ. It is accessed via the BR-101 highway and the Southeast railway network, by MRS Logística S.A. In addition to having a container terminal, it has exclusive "piers" for handling coal, ores and alumina (ANTAQ, 2012c). In addition to the ports of Santos and Rio de Janeiro, it is worth mentioning the ports of the South, due to their importance in the flow of products to the Southern Cone. They are the ports of Paranaguá, Itajaí and Rio Grande, located respectively in the states of Paraná, Santa Catarina and Rio Grande do Sul. The main river connection between Brazil and its neighbors is through the Paraguay River, which also bathes Argentina, Bolivia and Paraguay. From the river port of Corumbá, one of the largest of its kind in Brazil, a large part of shipments leave for the international market. Other ports such as Santarém, in Pará and Santana, in Amapá, are also important for foreign trade; however, the main destinations for their cargo are Europe and Asia (BRAZIL, 2016). The port of Corumbá is managed by the City of Corumbá. It can be accessed by road, through BR-262 or by rail, through the West network of Railroad Noroeste S/A. The port has a 200-meters pier and a general cargo warehouse of 1,400 m². The most relevant airports for cargo handling within MERCOSUR are located in the cities of São Paulo, Campinas, Rio de Janeiro, Buenos Aires and Montevideo (BRASIL, 2016). The table below shows the weekly frequencies between Brazil and its MERCOSUR partners, from Brazilian air carriers. It is noteworthy that among the logistical costs that a company has, what certainly stands out the most are the costs involved in cargo transportation (WANKE and FLEURY, 2006). In operations that involve great distances to travel, common in the international trade of goods; these costs may represent more relevant barriers than import taxes and local customs regulations.In fact, it is imperative that companies seeking international markets for their products understand the impact that international freight will have on their competitiveness, as these costs have the potential to make the operation unfeasible (VIEIRA, 2003).

**Table 2. Frequency of weekly flights between Brazil and Mercosur countries**

| Frequency of Weekly Flights: Brazil x Mercosur - June / 2016 | | | | |
|---|---|---|---|---|
| Destiny | Agreed Mixed | Agreed Load | Allocated mixed | Allocated Load |
| Argentina | 133 | 7 | 133 | 6 |
| Bolivia | 24 | 2 | 14 | 1 |
| Paraguay | Unlimited | Unlimited | 25 | 2 |
| Uruguay | Unlimited | Unlimited | 55 | 0 |
| Venezuela | 21 | 14 | 7 | 5 |

Source: ANAC - National Civil Aviation Agency

Each transport mode has its own operational characteristics, and these characteristics are decisive for their costs and the amount of service they can deliver (WANKE and FLEURY, 2006).

# MATERIALS AND METHODS

This research fits as an applied research as to its ends, because as defined by Vergara (2009, p. 45), applied research is fundamentally motivated by the need to solve concrete problems, whether they are more immediate or not. As already mentioned, one of the motivations for this paper is to seek a better understanding of the dynamics of current Brazilian exports so that it is possible to identify the routes used and their respective viability. A documentary research was carried out, considering that there was the use of data as archives of public agencies for further analysis. (GIL, 2002). The sources of this documentary research were data and statistics from government agencies; like ANTT and ANTAQ, and of public authorities like the Federal Revenue of Brazil. All of Brazilian foreign trade statistics, registered and stored in the "Alice Web" system, maintained by the Ministry of Industry, Foreign Trade and Services, as well as the registered foreign trade statistics, are characterized as the universe of documentary research carried out in this paper. by the Ministry of Development between 2011 and 2015 and those extracted from the

literature on topics related to International Logistics in recent years. The analyzed sample is considered under the methodological aspect as being by accessibility and by clusters.

**Data Collection and Data Processing:** The data from the documentary research were mostly extracted from the Foreign Trade Information Analysis System, called "Alice Web", maintained by the Ministry of Industry, Foreign Trade and Services. Data were also used in the research of BNDES, ANTT reports and ANTAQ.Field survey data was collected from international road freight carriers, shippers and railroad concessionaires. The Alice Web system, allows reports to be generated crossing a series of information about Brazilian exports and imports. For the complete survey, a total of 24 reports were generated. 12 of which are called exports by States x Country and 12 are called exports by Municipality x Country. The States x Country reports contained statistical data on exports from the states of Minas Gerais, São Paulo and Rio de Janeiro with the countries of Argentina, Bolivia, Paraguay and Uruguay. In addition, the following parameters were selected: Chapter 15 to Chapter 22 of the NCM - MERCOSUR Common Nomenclature, from 2011 to 2015 and detailed filters (modal).The Municipality x Country reports, on the other hand, contains export data detailed by municipalities in the survey states and bound for Argentina, Bolivia, Paraguay and Uruguay. The parameters selected in this report were the same as those previously mentioned, that is, Chapter 15 through Chapter 22 of the NCM.

all statistics used were extracted, "Alice Web", allows the user to view only the port or customs post where the cargo was exported. In the road and sea modes, this information is sufficient to be able to process the statistics, but in the case of the railroad and waterway modalities, it would be essential to control exactly the point where the cargo undergoes the overflow and enters the railway circuit towards the country of destination.

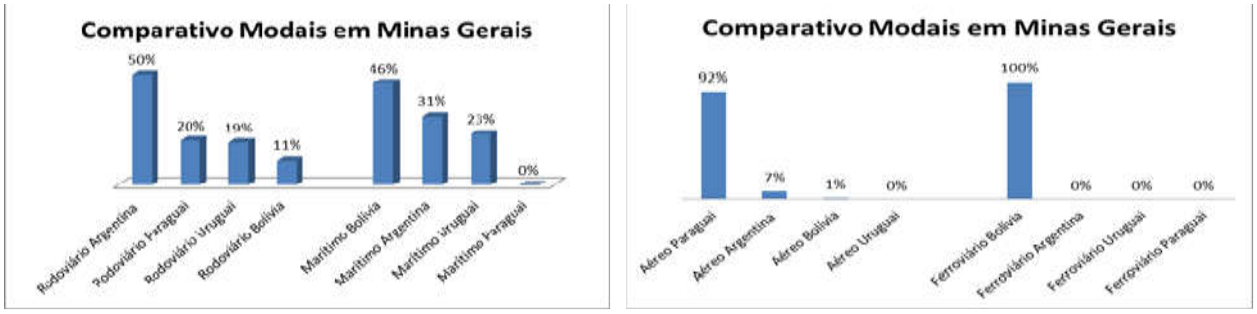
# RESULTS

In order to understand which is the most used modal, regarding the products analyzed in this research and in exports originating in the state of Minas Gerais, all data related to exports of items classified between chapters 15 and 22, of (NCM), were collected in the period between 2011 and 2015 and destined to Argentina, Bolivia, Paraguay and Uruguay.In the surveyed period, more than 27 thousand tons of cargo were transported between the Brazilian states and the surveyed destinations, which sum approximately US$ 80 million. Argentina was the main destination for mining exports, followed by Paraguay, Uruguay and Bolivia, respectively, as shown in the previous table.The transport of these exports to their destination countries was carried out, in its majority, by road. Table 1 shows not only the absolute total, but also the relative values of the usage of each modal. Although it was already expected that the road modal would be the predominant one, it was believed that the imbalance would not be so great.

**Table 3. Exports Minas Gerais: Modal x Country**

| Exports Minas Gerais - Modal x Country | | | | | | |
|---|---|---|---|---|---|---|
| **Modal** | **Argentina** | **Bolivia** | **Paraguay** | **Uruguay** | **Total by Modal** | **Percentage** |
| Road | 38.208.314,00 | 8.673.062,00 | 15.654.461,00 | 14.854.794,00 | 77.390.631,00 | 97,11% |
| Maritime | 214.469,00 | 321.418,00 | 0,00 | 157.093,00 | 692.980,00 | 0,87% |
| Railway | 0,00 | 979.596,00 | 0,00 | 0,00 | 979.596,00 | 1,23% |
| Air | 47.000,00 | 1.646,00 | 578.162,00 | 4.344,00 | 631.152,00 | 0,79% |
| **Total by Country** | 38.469.783,00 | 9.975.722,00 | 16.232.623,00 | 15.016.231,00 | 79.694.359,00 | 100,00% |

Source: Personal compilation




Source: Personal compilation

**Graph 1. Comparison between modes Minas Gerais: Road x Maritime and Aerial x Rail**

Thestatistical data generated in the reports, State x Country, were consolidated in order to obtain the participation of the modals in the exports of each state in the period covered by the research. Also in possession of the information about the municipalities that generated these exports and the customs posts and ports that left the country, it was possible to calculate the average road distances of each state to the main export exit points. To calculate these average distances, all road distances between the cities that registered exports and the customs offices, airports and ports used were calculated first, with the help of the Google Maps API application. Each city was assigned a load, according to its participation in exports within its respective state. By calculating the weighted average, it was determined the average distances that exporters in each state need to travel until they reach the borders of the countries they are selling or to the nearest ports.

**Research limitations:** Due to a limitation of the methodology used in this research, it was not possible to measure the average distances of exports made by rail and waterway modes. The database from which

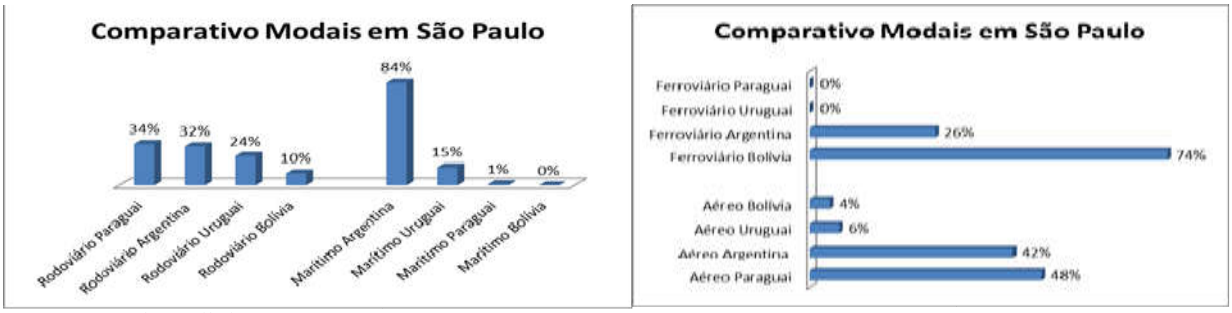
The remaining modals have an extremely marginal role, added together they do not exceed 3% of the total. It is also noted that some modes are extremely irrelevant for some destinations. These are the cases of the railway modal for Argentina, Paraguay and Uruguay and the marine modal for Paraguay. There was no record of a single export for these combinations. In fact, as it can be seen in Table 1, the use of a given modal can vary a lot according to the country of destination. For example, there are no transactions carried out by the maritime modal to Paraguay, whereas Bolivia (also without a way out into the ocean like Paraguay) was the destination that, in terms of value, received the most exports by this means. It is important to note that the road transport, due to its greater global representation, is the one with the highest degree of relationship with the state's trade balance. In order to better exemplify the different participation relationships that the modals present, according to the destination country, the following graph shows a succinct comparison between the modals used in the state. In the maritime modal, we observed that although Uruguay and Argentina are connected to the Atlantic Ocean,

they receive fewer exports by sea than Bolivia, which needs to use the Chilean port of Arica, in the Pacific Ocean. Paraguay, also without direct access to the ocean, did not register any imports by sea. It is also observed, that all exports made by rail have only one destination, Bolivia. In the air transport sector, Paraguay's participation stands out, which despite being the destination of only 20% of global exports, receives 92% of sales transported by air from Minas Gerais. Argentina with 7% and Uruguay with 1% complete the graph. The analyzes made, using only data from the state of Minas Gerais, is more than enough to conclude that the road transport is the main means for food products destined to the surveyed countries. However, they are insufficient to understand what are the main factors that make it the main modal and why other means have such low participation.

followed by Paraguay, Uruguay and Bolivia. Even with a massively larger volume than the one sold by the state of Minas Gerais, the ratio of the participation of the modes used in exports by São Paulo are not very different from those of the state of Minas Gerais. Once again, road transport prevails, transporting more than 90% of the total traded goods. Rail and air modals also have a marginal role, as was seen in the data referring to Minas Gerais. Each modal adds just over 1% of participation. The highlight is the greater participation of the maritime modal, exceeding 7% and the inclusion of transport by river, even if only when the destination of the cargo is Uruguay. Analyzing the road modal by destination, we observed a very balanced distribution between countries and with a proportion very similar to that shown in Graph 03.

**Table 4. Exports in São Paulo: Modal x Country**

| Exports São Paulo - Modal x Country | | | | | | |
|---|---|---|---|---|---|---|
| **Modal** | **Argentina** | **Bolivia** | **Paraguay** | **Uruguay** | **Total by Modal** | **Percentage** |
| Road | 407.872.872,00 | 134.684.801,00 | 431.165.135,00 | 310.357.322,00 | 1.284.080.130,00 | 90,26% |
| Maritime | 88.643.782,00 | 731.311,00 | 121.702,00 | 15.762.425,00 | 105.259.220,00 | 7,40% |
| Railway | 4.109.378,00 | 11.906.456,00 | 0,00 | 0,00 | 16.015.834,00 | 1,13% |
| Air | 6.528.219,00 | 693.432,00 | 7.556.593,00 | 880.322,00 | 15.658.566,00 | 1,10% |
| Waterway | 0,00 | 0,00 | 0,00 | 1.595.674,00 | 1.595.674,00 | 0,11% |
| **Total by Country** | 507.154.251,00 | 148.016.000,00 | 438.843.430,00 | 328.595.743,00 | 1.422.609.424,00 | 100,00% |




Source: Personal compilation

**Graph 3. Comparison between modes São Paulo: Road x Maritime and Aerial x Rail**

**Table 5. Exports in Rio de Janeiro: Modal x Country**

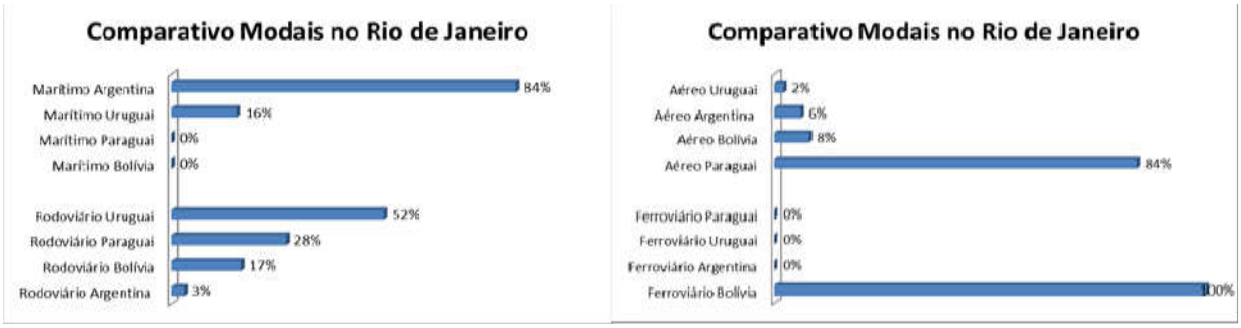
| Exports Rio de Janeiro - Modal x Country | | | | | | |
|---|---|---|---|---|---|---|
| **Modal** | **Argentina** | **Bolivia** | **Paraguay** | **Uruguay** | **Total by Modal** | **Percentage** |
| Road | 250.861,00 | 1.470.064,00 | 2.334.506,00 | 4.382.455,00 | 8.437.886,00 | 41,21% |
| Maritime | 9.973.230,00 | 0,00 | 0,00 | 1.893.484,00 | 11.866.714,00 | 57,96% |
| Railway | 0,00 | 107.440,00 | 0,00 | 0,00 | 107.440,00 | 0,52% |
| Air | 3.930,00 | 5.103,00 | 52.714,00 | 1.202,00 | 62.949,00 | 0,31% |
| Waterway | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00% |
| **Total by Country** | 10.228.021,00 | 1.582.607,00 | 2.387.220,00 | 6.277.141,00 | 20.474.989,00 | 100,00% |

Source: Personal compilation

It is therefore necessary to compare data from the state of Minas Gerais with other states, in order to better assess the existing criteria used to choose the modal. In order for this objective to be achieved, data on exports from two other states were analyzed and consolidated. When comparing the use of modes in exports from São Paulo and Rio de Janeiro, for the same destinations it was possible to draw parallels and define which characteristics of origin and destination had the greatest impact the selected means of transport used. The interesting thing about observing these two states is that they have different characteristics from the state of Minas Gerais. With a registered volume of exports in the analyzed period of more than US$ 1.4 billion, the state of São Paulo, the largest exporter of food products in Brazil, has a similarity when it comes to destination to that of the state of Minas Gerais. The percentages are shown in the graph below, and as it can be seen; Argentina was also the main destination,

The largest participation was with Paraguay, with 34%, followed by Argentina, 32%, Uruguay, 24 % and finally Bolivia, with 10%. On the other hand, the maritime modal shows a great imbalance. More than 80% of the cargo volume transported by this modal has a single destination, Argentina. Around 15% goes to Uruguay and the rest is distributed between Bolivia and Paraguay. The railway modal, on the other hand, also presents itself in a very unbalanced way, with most of the transport through this mode having Bolivia as its destination, 74% in total to be more exact. The rest are destined to Argentina, 24% of exports in total. As with air exports from Minas Gerais, exports originating in São Paulo also have Paraguay as their main destination, but there is a greater balance with other destinations, mainly to Argentina, which receives 42% of exports by this means, while Paraguay receives 46%. Bolivia and Uruguay share the rest of the participation.

Among the states analyzed, Rio de Janeiro has the lowest volume of exports with the countries in which the research is focused. Between 2011 and 2015 Rio de Janeiro exported a little more than US $ 20 million. In terms of cargo volume, this represented more than 5,800 tons of goods. Like Minas Gerais and São Paulo, Argentina was also the main destination of the NCM chapters in focus, with around 50% participation. The analysis of exports by Rio de Janeiro modals brings a new aspect unseen in this research so far. The participation of the road mode is surpassed by the sea mode. Almost 60% of exports went by sea, towards their destination, while just over 40% went by road. Meanwhile, rail and air modes have failed to accumulate even 1% of exports. As the main destination of all the analyzed states, Argentina has the highest degree of correlation with the modes used. Only 3% of cargo transported by road is destined for that country, while Uruguay appears as the main recipient of cargo transported by trucks. The maritime modal has only two destinations, Argentina with 84% and Uruguay with 16%. However, the most interesting thing to notice is that Uruguay, even though it is connected to the ocean and having a sea port in its capital, Montevideo, receives the majority of food and beverage imports from the state of Rio de Janeiro by land, and not by sea as it was expected.




Source: Personal compilation

**Graph 5. Comparison between Rio de Janeiro - Highway x Maritime modes and Rail x Airmodes**

**Table 6. Comparative Table - Scheduled trips**

| Trips scheduled between 10/10/2016 and 10/11/2016 | | | | |
|---|---|---|---|---|
| Origin | Destiny | Direct Travels | Indirect Travels | Traffic Time |
| Rio de Janeiro | Buenos Aires | 4 | 6 | 4 days |
| Rio de Janeiro | Montevideo | 4 | 6 | 6 days |

Source: www.zarpar.com/programacao-navios

**Table 7. Averages of distances**

| Weighted Average Distances (Km) - Main Ports x States | | | | | | |
|---|---|---|---|---|---|---|
| States | Port of Santos | Port of Rio | Corumbá | Chuí | Foz do Iguaçu | Uruguaiana |
| Minas Gerais | 366,49 | 491,91 | 1.438,32 | 1.902,27 | 1.150,52 | 1794,91 |
| São Paulo | 255,58 | 589,54 | 1.272,61 | 1.825,89 | 963,72 | 1612,25 |
| Rio de Janeiro | 408,36 | 107,35 | 1.760,64 | 1.984,60 | 1.390,37 | 1885,70 |

Source: Personal compilation

It should be noted that, according to a consultation with a major ship owner in the market, the number of trips scheduled between the ports of Rio de Janeiro and Montevideo was the same as the number of trips between the ports of Rio de Janeiro and Buenos Aires, hypothetically, the reason for the small participation is the low supply of ships between the two points, so this theory is excluded. The only difference, as seen in the table below, is the greater number of travel days, it is 04 days to the port of Buenos Aires and 06 to the Uruguayan capital. The railway modal presents a single destination, Bolivia; all of the US$ 107,440.00 exported from Rio de Janeiro by railway went to the Andean country. Concluding the analysis of the air modal, Paraguay appears again as the main destination, with a wide advantage over the second destination, Bolivia with 84% of the total transported. As interesting as is analyzing exports from the point of view of their modes, it also is analyzing the exact point of origin from where they are dispatched. As a report of this nature is not possible to be removed from the database that this research was based on, it was necessary to resort to a methodology that somehow allowed the classification of shipments according to an exact geographical point. For that purpose, all the cities that registered exports in the period covered by the survey were listed. Then, all these cities, which are 132 in total (101 in São Paulo, 20 in Minas Gerais and 11 in Rio de Janeiro) had their road distances measured from all ports that also registered exports between 2011 and 2015. The calculation of these distances was obtained from the Google Maps API software. The weighted averages for each state by port of departure are shown in the previous table. In order to minimize the distorted effects that the calculations of averages can cause, a new average of the distances for each state was recalculated, taking into account the volume exported by each city. An in-depth analysis from an average point of origin helps to understand the factors that influence the choice of the modal by exporters and importers. When comparing the results of the three states, it is possible to observe standardized behaviors. Let us start by analyzing Rio de Janeiro, the state with the largest share of the maritime modal share in its exports. The average distance from cities, point of origin, to the nearest seaports is the smallest identified. It is only 107 kilometers to the port of São Sebastião, in the central region of Rio de Janeiro and 113 kilometers to the port of Itaguaí, west of the capital of Rio de Janeiro. Approximately 58% of the total value exported by the state came in from these two ports. When compared to São Paulo, one can better observe the importance of being close to a port so that the maritime modal is chosen for the commercial transaction. The cities that registered exports to the countries surveyed are, on average, 255 kilometers from the port of Santos, the main port in the country. However, only 7% of its exports are done by sea. It should be noted that this average is twice as much as the state of Rio de Janeiro and represents a 50% share of transport by sea.Now the state of Minas Gerais is observed, its exporting cities are at an average distance of 366 kilometers from the Port of Santos, 490 kilometers from the Port of São Sebastião and 463 from the Port of Itaguaí. Between 2011 and 2015 the total exported by the state via maritime modal did not exceed 1%. Let us now analyze the results

presented from the road modal's point of view. Rio de Janeiro, the smallest in terms of participation in this mode, has the following average distances to the ports that most record exports from Rio de Janeiro:1185 kilometers from Rio to Uruguaiana, 1390 kilometers to Foz do Iguaçu, 1760 kilometers to Corumbá and 1984 kilometers to Chuí, in Rio Grande do Sul. The distance from Minas Gerais, a state that practically only exports by road, to the same points is 1150 kilometers to Foz do Iguaçu, 1794 to Uruguaiana, 1438 to Corumbá and 1900 kilometers to Chuí. It can be noted, as shown in the previous table, that Minas Gerais even has some shorter distances to some cities, but not all, and the difference in mileage is no more than 18%.The data shows that the road modal, despite being the most used, is not the preferred one. The logic reviewed in this work, in the bibliographic review section, that the waterway modal is more suitable for transporting products with low added value to long distances prevails.

# CONCLUSION

This work aimed to analyze a large amount of data related to Brazilian foreign trade in order not only to ascertain the facts but also to understand why they occurred. The verified facts show that the Brazilian foreign trade practiced within the South American continent depends massively on the road transport to work and that in the state of Minas Gerais this is practically the only modal used in exports to Argentina, Bolivia, Paraguay and Uruguay. When analyzing the numbers presented in this work, some macroeconomic and microeconomic conclusions can be explained. The first, of a macroeconomic nature, is that an integrated and balanced logistics in all its modes would give a much greater economic balance to the country, making the geographical locations of the companies impact less on the respective international competitiveness, thus enabling these would bring economic development to more remote areas of Brazil. Currently, companies located close to ports, railway and waterway terminals or which are at road distances that allow their goods to be transported by trucks abroad have a great competitive advantage in the South American regional market. Another conclusion, this time, microeconomic, is that it is difficult for a company to be competitive in several markets at the same time, precisely because of the reasoning presented in the previous paragraph. A company close to the port of Santos has advantages when selling its products with Argentina and Uruguay, for example, but will not be able to compete in the same way in Paraguay, a country without access to the sea. This directly affects economies of scale and shows an interesting aspect of Brazilian foreign trade, the punctuality of exports. In other words, companies export when the destination is convenient.

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